

606-73

AU 3309

12

WO 094028811 A1

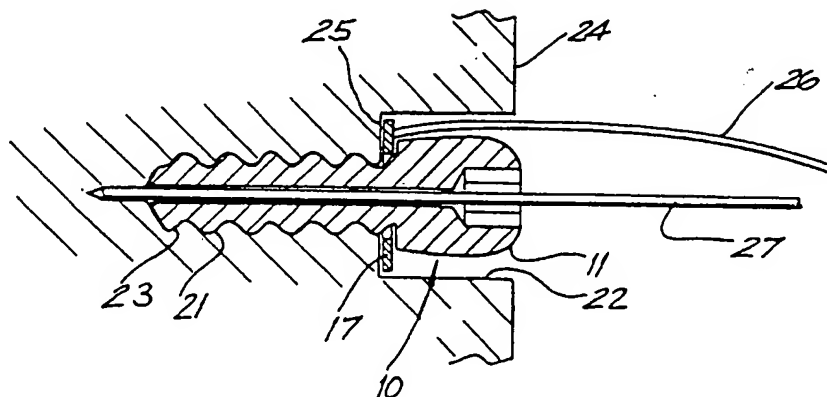
DEC 1994

INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁵ : A61B 17/58, A61F 2/08	A1	(11) International Publication Number: WO 94/28811 (43) International Publication Date: 22 December 1994 (22.12.94)
(21) International Application Number: PCT/AU94/00296 (22) International Filing Date: 3 June 1994 (03.06.94) (30) Priority Data: PL 9200 4 June 1993 (04.06.93) AU (71) Applicant (for all designated States except US): HIP DEVELOPMENTS PTY LTD [AU/AU]; 286 Pacific Highway, Crows Nest, NSW 2065 (AU). (72) Inventor; and (75) Inventor/Applicant (for US only): ROGER, Gregory, James [AU/AU]; 286 Pacific Highway, Crows Nest, NSW 2065 (AU). (74) Agent: F.B. RICE & CO.; P.O. Box 117, 28A Montague Street, Balmain, NSW 2041 (AU).	(81) Designated States: AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, ES, FL, GB, GE, HU, JP, KG, KP, KR, KZ, LK, LU, LV, MD, MG, MN, MW, NL, NO, NZ, PL, PT, RO, RU, SD, SE, SI, SK, TJ, TT, UA, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG). Published With international search report. <div style="text-align: center;"> <p>103 alone</p> <hr/> <p>15-21</p> </div>	

(54) Title: SURGICAL SCREW AND WASHER



(57) Abstract

A surgical fastener for fixation of graft tendon (26) in a bone hole comprising a screw (10) having a head (11), neck (12), and shank (13), and a washer (17) disposed about the neck. The tendon (26) is attached to the washer (17) so as to ensure that the tendon (26) is immobilised between the head (11) of the screw (10) and the wall of the bone hole thereby reducing pistoning under load and reducing graft failure. In one embodiment, the fastener includes a bone plug (38) disposed about the neck (12) of the screw (10) between the head (11) and the washer (17), the neck (12) being adapted to laterally press the bone plug (38) and thereby immobilise a tendon (26) attached to the washer between the bone plug (38) and the wall of the bone hole. In another embodiment, the invention consists in a surgical staple (60) having two substantially parallel legs (61), a transverse head member (62) and a washer (66) which holds a loop of tendon (26) under the staple (60) when it is inserted into a bone.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	GB	United Kingdom	MR	Mauritania
AU	Australia	GE	Georgia	MW	Malawi
BB	Barbados	GN	Guinea	NE	Niger
BE	Belgium	GR	Greece	NL	Netherlands
BF	Burkina Faso	HU	Hungary	NO	Norway
BG	Bulgaria	IE	Ireland	NZ	New Zealand
BJ	Benin	IT	Italy	PL	Poland
BR	Brazil	JP	Japan	PT	Portugal
BY	Belarus	KE	Kenya	RO	Romania
CA	Canada	KG	Kyrgyzstan	RU	Russian Federation
CF	Central African Republic	KP	Democratic People's Republic of Korea	SD	Sudan
CG	Congo	KR	Republic of Korea	SE	Sweden
CH	Switzerland	KZ	Kazakhstan	SI	Slovenia
CI	Côte d'Ivoire	LI	Liechtenstein	SK	Slovakia
CM	Cameroon	LK	Sri Lanka	SN	Senegal
CN	China	LU	Luxembourg	TD	Chad
CS	Czechoslovakia	LV	Latvia	TG	Togo
CZ	Czech Republic	MC	Monaco	TJ	Tajikistan
DE	Germany	MD	Republic of Moldova	TT	Trinidad and Tobago
DK	Denmark	MG	Madagascar	UA	Ukraine
ES	Spain	ML	Mali	US	United States of America
FI	Finland	MN	Mongolia	UZ	Uzbekistan
FR	France			VN	Viet Nam
GA	Gabon				

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 94/00296

Box I Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

This international search report has not established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claim Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. Claims 1-18
Screw and washer for attaching tendon to bone
2. Claims 19-26
Staple for attaching tendon to bone
as reasoned on the extra sheet:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.: 1-18

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member	
US 5129902			
EP 260970	GB 8622563		
FR 2655840			
DE 2747312			
EP 172130	DE 3434807		
WO 9203980	AU 85350/91	EP 547134	
DE 4127550			
US 4828562	AU 29613/89 ZA 8900801	EP 330328	JP 1274757
END OF ANNEX			

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 94/00296

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.⁵ A61B 17/58, A61F 2/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC A61B 17/18 17/58 A61F 1/00 1/24 2/08

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU: IPC as aboveElectronic data base consulted during the international search (name of data base, and where practicable, search terms used)
DERWENT: screw and washer, tendon or ligament

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
X Y A	US,A,5129902 (GOBLE et al) 14 July 1992 (14.07.92) column 5 lines 32-55, figures 6,7	1,5,6 2-4 7,13
X Y A	EP,A,260970 (IMPERIAL COLLEGE OF SCIENCE & TECHNOLOGY) 23 March 1988 (23.03.88) column 5 lines 34-39, figure 1.	1 2-4 7,13

Further documents are listed
in the continuation of Box C.

See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance
 "E" earlier document but published on or after the international filing date
 "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
 "O" document referring to an oral disclosure, use, exhibition or other means
 "P" document published prior to the international filing date but later than the priority date claimed

"T"

later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
 "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
 "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
 "&" document member of the same patent family

Date of the actual completion of the international search
30 August 1994 (30.08.94)

Date of mailing of the international search report

8 Sept 1994 (08.09.94)

Name and mailing address of the ISA/AU

AUSTRALIAN INDUSTRIAL PROPERTY ORGANISATION
 PO BOX 200
 WODEN ACT 2606
 AUSTRALIA

Facsimile No. 06 2853929

Authorized officer

C. Melhuish

D MELHULSH

Telephone No. (06) 2832426

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU 94/00296

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate of the relevant passages	Relevant to Claim No.
X	WO,A,92/03980 (HIP DEVELOPMENTS PTY LTD) 19 March 1992 (19.03.92) figure 3	1-4
X Y	FR,A,2655840 (BIOTECNIC SA) 21 June 1991 (21.06.91) figure 5	1 2,3,4
Y	DE,A,2747312 (ULLRICH et al) 26 April 1979 (26.04.79) figure 2	2,3
Y	EP,A,172130 (MECRON MEDIZINISCHE PRODUKTE GMBH) 19 February 1986 (19.02.86) figure 1	4
A	DE,A,4127550 (TELOS-HERSTELLUNG UNG VERTRIEB MED-TECHN GERÄTE GMBH) 25 February 1993 (25.02.93) figures 3,4	5,6
A	US,A,4828562 (KENNA) 9 May 1989 (09.05.89) column 4 lines 60-64, column 6 lines 11-18	7,13

- 1 -

SURGICAL SCREW AND WASHERFIELD OF THE INVENTION

The present invention relates generally to a fastener for attaching tendons to bones and in particular to a surgical screw having a washer for immobilising tendons within pre-formed holes in bone.

BACKGROUND ART

It is known that damaged anterior cruciate ligaments can be repaired by grafting a portion of patellar tendon, which has been harvested with blocks of bone physiologically bound at each end, between the femur and tibia at the knee joint. The harvested blocks of bone are typically positioned in pre-drilled holes in the femur and tibia.

This method of ligament repair is often a difficult and time consuming operation with consequent concerns about patient comfort and safety. The harvesting of patellar tendon can also itself cause problems for the patient. In many patients the graft tendon is also often not in a suitable physiological condition for use. It is, therefore, desirable to harvest tendon without bone attached and then position the tendon at the required site such that the bone growth fixates the tendon to the bone.

A main requirement for fixation is that the graft tendon be held securely without moving or pistoning within a bone hole.

Current methods for fixation of a tendon include a staple, around which the tendon is positioned prior to the staple being placed within the bone. This method suffers two main disadvantages. Firstly, on the femoral side, the staple is applied to the outer surface of the femur and an extra incision is therefore required. Secondly, because fixation is outside the femur and the tendon lies in a bone tunnel of around 40mm in length, the elasticity of the tendon allows pistoning under load and so healing to

- 2 -

the bone of the tendon graft may fail or be a weak, fibrous healing that allows later loosening.

DISCLOSURE OF THE INVENTION

According to one aspect the present invention
5 consists in a surgical fastener, the fastener being a screw having a head, a neck and a shank with an end distal the head, the shank having a thread formed along at least a portion of its length, the head being generally hemispherical and of a diameter greater than the shank,
10 and an annular washer being disposed about the neck of the screw intermediate the head and the shank.

The thread in longitudinal section along the entirety of the thread is preferably devoid of an outermost cutting line. In one embodiment the screw has a shank having a
15 thread formed along the entirety of the shank. The screw thread is preferably approximately or wholly sinusoidal in longitudinal section so as to present a soft thread devoid of an outermost cutting line.

The screw preferably has a drive socket concentric
20 with the head and a longitudinal cannulation concentric of the shank.

In a further embodiment the annular washer is positioned adjacent the head of the screw and preferably has at least one hole in its annular portion. The washer
25 more preferably has four holes in its annular portion, the four holes preferably confined to one half of the annular portion.

In a second aspect an annular plug made of bone is disposed about the neck of the screw between the annular
30 washer and the head. The neck of the screw in this embodiment is preferably adapted such that the bone plug is compressed laterally when the screw is in use.

In a further embodiment the present invention comprises a method for attaching one end of a tendon to a
35 bone, using the surgical fastener according to the first

- 3 -

aspect of the invention, comprising the steps of:

- (a) forming a hole in the bone, the hole having a first end and a second end and comprising two portions, the first portion, adjacent the first end, having a diameter larger than the diameter of the second portion, distal to the first end, such that there is formed an annular abutment in the hole;
- (b) attaching the one end of the tendon to the washer;
- (c) drawing the washer with the tendon attached into the hole such that the washer is positioned proximate the annular abutment; and
- (d) screwing the surgical screw into the hole such that the washer is abutted with the annular abutment and the tendon is immobilised with the head of the screw forcing the tendon into abutment with the bone within the first portion of the hole.

The tendon preferably has sutures secured to its one end, the sutures being preferably tied to one or more holes in the annular portion of the washer. The sutures are more preferably tied to four holes in the washer, the four holes being preferably confined to one half of the annular portion.

The surgical screw is preferably of a length such that the one end of the shank reaches the outer cortex of the bone when the screw is screwed into the bone. The screw is preferably inserted using the drive socket.

The bone is preferably a femur and the hole in the bone is preferably formed in the femoral condyle by a drill bit.

The screw is preferably cannulated so as to accept large diameter Kirschner wires or the like that allow accurate guiding of the screw arthroscopically.

In another embodiment the present invention comprises a method for attaching one end of a tendon to a bone, using the surgical fastener according to the second aspect

- 4 -

of the invention, comprising the steps of:

- (a) forming a hole in the bone;
- (b) attaching the one end of the tendon to the annular washer;
- 5 (c) positioning the washer concentrically and proximate one end of the annular bone plug;
- (d) inserting the washer and the bone plug into the hole using an insertion means such that the washer is distal the entrance of the hole; and
- 10 (e) screwing the surgical screw into the hole such that the bone plug is laterally compressed, thereby immobilising the tendon between the wall of the hole and a substantial portion of the length of the bone plug.

In a preferred embodiment of the invention, the
15 annular bone plug prior to insertion in the bone hole is mounted in a holder, the holder having a first and second end and preferably surrounding the bone plug. In a more preferred embodiment the washer and bone plug are both mounted in the holder such that the tendon attached to the
20 washer lies substantially longitudinally along the length of the bone plug. The holder preferably has a bulge proximate the washer and bone plug to accommodate the tendon.

The insertion means preferably comprises a plunger
25 positioned at the second end of the holder that is adapted to expel the bone plug and washer from the holder into the bone hole.

The annular washer, bone plug, holder and surgical screw are preferably positioned on a guide wire centrally
30 positioned within the hole.

According to a third aspect, the present invention consists in a surgical fastener, the fastener being a staple for attaching a graft tendon to a bone, the surgical staple comprising two substantially parallel legs
35 interconnected by a transverse head member, each leg being

- 5 -

of substantially the same length and having a free end portion connected substantially at a right angle to a head portion, such that the head member is laterally displaced from the free end portions and a washer disposed around
5 the free end portions proximate the right angle connection with the head portions.

The surgical staple preferably has two parallel legs, each leg of the same length and having a free end portion connected at a right angle to a head portion.

10 The transverse head member interconnecting the two head portions is preferably canted downwardly from the plane of the head portions.

The surgical staple is preferably comprised of one linear member folded to the required shape. The linear
15 member is preferably a wire with the free end portions preferably having a sharp arrow tip to facilitate insertion of the staple into the bone. The portions of the wire likely to come into contact with the tendon are preferably rounded to prevent damage to the tendon. The
20 wire is preferably a biologically inert metal.

The washer is preferably oval in shape with rounded edges to prevent damage to the graft tendon. There are preferably two holes laterally displaced in the washer for each of the legs. The washer is preferably made of a
25 biologically inert metal.

In a further embodiment the present invention comprises a method for attaching a loop of tendon to a bone using the surgical fastener according to the third aspect of the invention comprising the steps of:

- 30 (a) positioning the washer through the loop of the tendon;
(b) inserting the free end portions of the staple's legs through the washer so as to position the loop of tendon within the staple; and
(c) inserting the staple into the bone such that the
35 tendon is firmly secured to the bone both under the washer

- 6 -

and under the laterally displaced head member, such that any tilting of the staple under load will serve to press the head member more firmly onto the tendon thereby ameliorating loosening of the tendon and staple from the
5 bone.

The staple is preferably inserted into the bone at the required site using an appropriate hammer like tool.

BRIEF DESCRIPTION OF THE DRAWINGS

By way of example only, preferred embodiments of the
10 invention will be described with reference to the accompanying drawings in which;

Fig. 1 is a longitudinal sectional view of one embodiment of the surgical fastener of the present invention;

15 Fig. 2 is a plan view of one embodiment of the annular washer of the present invention;

Fig. 3 is a longitudinal sectional view of the surgical screw and washer of Fig. 1 and Fig. 2 respectively, after insertion in a bone;

20 Fig. 4 is a longitudinal sectional view of a second embodiment of the surgical fastener;

Fig. 5 is a longitudinal sectional view of the surgical screw of Fig. 4 after insertion into a bone;

25 Fig 6 is a longitudinal sectional view of one embodiment of the bone plug holder;

Fig. 7 is a longitudinal sectional view of another embodiment of the bone plug holder;

Fig. 8 is an end elevational view of the holder of Fig. 7; and

30 Fig. 9 is a perspective view of another embodiment of a surgical fastener.

A surgical screw for attaching graft tendon to bone is generally shown as 10 in Fig. 1.

The surgical screw 10 includes a generally
35 hemispherical head 11, a neck 12 and a shank 13. The

- 7 -

shank 13 has a thread 14 that is approximately sinusoidal in longitudinal section so as to present a soft thread devoid of an outermost cutting line. An hexagonal drive socket 15 is concentrically positioned within the head 11. The screw 10 also has a central cannulation 16 along the length of the screw 10.

An annular washer 17 is disposed about the neck 12 of the screw 10. As is more clearly depicted in Fig. 2, the annular washer 17 has four holes 18 in its annular portion 19. The holes 18 are confined to one half of the annular portion 19.

The position of the surgical screw 10 when attaching a tendon to a bone is generally depicted in Fig. 3.

In order to attach a tendon using the screw 10 and washer 17 of Fig. 1 and Fig. 2, a hole 21 comprised of two portions 22 and 23 is firstly drilled into the bone 24. The first portion 22 has a diameter larger than that of the second portion 23 such that an annular abutment 25 is formed in the hole 21.

A tendon 26 having sutures secured to one end (not depicted) is then tied to the washer 17 using the holes 18. The washer 17 with the tendon 26 attached is then drawn into the hole 21 around the guide wire 27 such that the washer 17 is positioned proximate the annular abutment 25.

The surgical screw 10 is then screwed into the hole 21, guided by the central guide wire 27 such that the washer 17 is forced into abutment with the annular abutment 25. The tendon 26 is also immobilised against the wall of the first portion 22 of the hole 21 by the head 11 of the screw 10.

A second embodiment of the surgical screw is generally shown as 30 in Fig. 4.

The surgical screw 30 includes a head 31, a tapered neck 32 and a shank 33. The shank 33 has a thread 34 that

- 8 -

is approximately sinusoidal in longitudinal section so as to present a soft thread devoid of an outermost cutting line. An hexagonal drive socket 35 is concentrically positioned within the head 31. The screw 30 also has a
5 central cannulation 36 along the length of the screw 30.

An annular washer 37 is disposed about the neck 32 of the screw 30. An annular bone plug 38 is disposed about the neck 32 between the washer 37 and the head 31.

The position of the surgical screw 30 when attaching
10 a tendon to a bone is generally depicted in Fig. 5.

In this embodiment, when the screw 30 is screwed into the hole 39 in the bone 41, the bone plug 38 is laterally compressed thereby immobilising the tendon 26 that is attached to the washer 37 against the wall of the
15 hole 39. The immobilisation of the tendon 26 between the bone plug 38 and the wall of the hole 39 ensures good fixation of the tendon 26 to the bone 41, thereby reducing pistoning of the tendon and healing time.

In order to insert the bone plug 38 and washer 37
20 into the hole 39, an apparatus generally shown as 50 in Fig. 6 is employed.

Prior to insertion of the bone plug 38 and washer 37 into the hole 39, a guide wire 51 is centrally positioned within the hole 39. A holder 52 is then positioned on the
25 guide wire 51. The holder 52 is a cylindrical sleeve into which the bone plug 38 is inserted. The bone plug 38 is cannulated and, therefore, slides along the guide wire 51 into the holder 52.

A washer 37 to which a tendon 26 is attached is then
30 slid over the guide wire 51 and positioned proximate one end 53 of the holder 52. An insertion means comprising a plunger 54 mounted at the other end 55 of the holder 52 expels the bone plug 38 from the holder 52 into the hole 39 along the guide wire 51. The washer 37 to which
35 the tendon 26 is attached, is positioned before the bone

- 9 -

plug 38 and is, therefore, inserted into the hole 39 ahead of the bone plug 38.

Once the washer 37 and bone plug 38 are positioned in hole 39 the plunger 54 is retracted and the holder 52 is removed from the guide wire 51.

After removal of the holder 52, the surgical screw 30 is then slid over the guide wire 51 and screwed into the hole 39. The neck 32 of the screw 30 compresses the bone plug 38 thereby immobilising the tendon 26 between the bone plug 38 and the wall of the hole 39.

Another embodiment of the holder 52 is depicted in Fig. 7 and Fig. 8. In this embodiment of the holder 52, a bulge 55 is provided on one side of the sleeve of the holder 52. Using this embodiment of the holder 52, the bone plug 38 and washer 37 to which a tendon 26 is attached are both inserted in the holder 52. The tendon 26 is positioned substantially longitudinally along the bone plug 38 and is accommodated within the bulge 55 of the holder 52.

A third embodiment of the present invention is generally shown as 60 in Fig. 9.

The surgical staple 60 includes two parallel legs 61 inter-connected by a rounded transverse head member 62. Each of the legs 61 comprises a free end portion 63 and a head portion 64 connected at right angles 65, such that the head member 62 is laterally displaced from the free end portion 63 of the legs 61. The surgical staple 60 also includes a washer 66 disposed around the free end portions 63 proximate the right angles 65 in the legs 61.

The free end portions have an arrow shaped tip 67 to facilitate insertion of the staple 60 into the bone.

The washer 66 is oval in shape with rounded edges 68 to prevent damage to the tendon 26 which is looped around the washer 66.

In order to secure the tendon 26 to a bone, the

- 10 -

staple 60 is hammered into a bone, with the tendon 26 secured both at the site of the washer 66 and the transverse head member 62.

Any loosening of the staple 60 under load serves to
5 further press the transverse head member 62 more firmly onto the tendon 26 thereby ameliorating any loosening of the tendon 26 from the bone.

It will be appreciated by persons skilled in the art that numerous variations and/or modifications may be made
10 to the invention as shown in the embodiments without departing from the spirit or scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive.

- 11 -

CLAIMS:-

1. A surgical fastener being a screw having a head, a neck and a shank with an end distal the head, the shank having a thread formed along at least a portion of its
5 length, the head being generally hemispherical and of a diameter greater than the shank, and an annular washer being disposed about the neck of the screw intermediate the head and shank.
2. The surgical fastener of claim 1 wherein the thread
10 in longitudinal section along the entirety of the thread is devoid of an outermost cutting line.
3. The surgical fastener of claim 2 wherein the screw has a shank having a thread formed along the entirety of the shank and being approximately or wholly sinusoidal in
15 longitudinal section so as to present a soft thread devoid of an outermost cutting line.
4. The surgical fastener of any one of claims 1-3 wherein the screw has a drive socket concentric with the head and a longitudinal cannulation concentric of the
20 shank.
5. The surgical fastener of any one of claims 1-4 wherein the annular washer has an annular portion, is positioned adjacent the head of the screw and has at least one hole in its annular portion.
- 25 6. The surgical fastener of claim 5 wherein the washer has four holes in its annular portion, the four holes being confined to one half of the annular portion.
7. A method for attaching one end of a tendon to a bone using the surgical fastener of any one of claims 1-6.
30 comprising the steps of:
 - (a) forming a hole in the bone, the hole having a first end and a second end and comprising two portions, the first portion, adjacent the first end, having a diameter larger than the diameter of the second portion, distal to
35 the first end, such that there is formed an annular

- 12 -

abutment in the hole;

(b) attaching the one end of the tendon to the washer;

(c) drawing the washer with the tendon attached into the hole such that the washer is positioned proximate the

5 annular abutment; and

(d) screwing the surgical screw into the hole such that the washer is abutted with the annular abutment and the tendon is immobilised with the head of the screw forcing the tendon into abutment with the bone within the first

10 portion of the hole.

8. The method of claim 7 wherein the tendon has sutures secured to its one end, the sutures being tied to one or more holes in the annular portion of the washer.

9. The method of claims 7 or 8 wherein the surgical
15 screw is of a length such that one end of the shank reaches the outer cortex of the bone when the screw is screwed into the bone.

10. The method of any one of claims 7-9 wherein the bone is a femur and the hole in the bone is formed in the
20 femoral condyle by a drill bit.

11. The method of any one of claims 7-10 wherein the screw is cannulated so as to accept large diameter Kirschner wires or the like that allow accurate guiding of the screw arthroscopically.

25 12. The surgical fastener of any one of claims 1-6 wherein an annular plug made of bone is disposed about the neck of the screw between the annular washer and the head, the neck of the screw being adapted such that the bone plug is compressed laterally when the screw is in use.

30 13. A method for attaching one end of a tendon to a bone using the surgical fastener of claim 12 comprising the steps of:

(a) forming a hole in the bone;

(b) attaching the one end of the tendon to the annular
35 washer;

- 13 -

- (c) positioning the washer concentrically and proximate one end of the annular bone plug;
- (d) inserting the washer and the bone plug into the hole using an insertion means such that the washer is distal
- 5 the entrance of the hole; and
- (e) screwing the surgical screw into the hole such that the bone plug is laterally compressed thereby immobilising the tendon between the wall of the hole and a substantial portion of the length of the bone plug.
- 10 14. The method of claim 13 wherein the annular bone plug prior to insertion in the bone hole is mounted in a holder, the holder having a first and second end and surrounding the bone plug.
- 15 15. The method of claim 14 wherein the washer and the bone plug are both mounted in the holder such that the tendon attached to the washer lies substantially longitudinally along the length of the bone plug.
16. The method of claim 15 wherein the holder has a bulge proximate the washer and the bone plug to accommodate the
- 20 tendon.
17. The method of any one of claims 14-16 wherein the insertion means comprises a plunger positioned at the second end of the holder that is adapted to expel the bone plug and washer from the holder into the bone hole.
- 25 18. The method of any one of claims 14-17 wherein the annular washer, bone plug, holder and surgical screw are positioned on a guide wire centrally positioned in the hole.
19. A surgical fastener, the fastener being a staple for
- 30 attaching a graft tendon to a bone, the surgical staple comprising two substantially parallel legs interconnected by a transverse head member, each leg being of substantially the same length and having a free end portion connected substantially at a right angle to a head
- 35 portion, such that the head member is laterally displaced

- 14 -

from the free end portions and a washer disposed around the free end portions proximate the right angle connection with the head portions.

20. The surgical fastener of claim 19 wherein the
5 surgical staple has two parallel legs, each leg of the same length and having a free end portion connected at a right angle to a head portion.
21. The surgical fastener of claims 19 or 20 wherein the
10 transverse head member interconnecting the two head portions is canted downwardly from the plane of the head portions.
22. The surgical fastener of any one of claims 19-21
wherein the surgical staple is comprised of one linear member folded to the required shape.
- 15 23. The surgical fastener of claim 22 wherein the linear member is a wire with the free end portions having a sharp arrow tip to facilitate insertion of the staple into the bone and the portions of the wire likely to come into
20 contact with the tendon are rounded to prevent damage to the tendon.
24. The surgical fastener of any one of claims 19-23
wherein the washer is oval in shape with rounded edges to prevent damage of the graft tendon and has two holes
laterally displaced for each of the legs.
- 25 25. A method for attaching a loop of tendon to a bone
using the surgical fastener according to any one of claims
19-24 comprising the steps of:-
- (a) positioning the washer through the loop of the tendon;
(b) inserting the free end portions of the staples' legs
30 through the washer so as to position the loop of tendon within the staple; and
- (c) inserting the staple into the bone such that the
tendon is firmly secured to the bone both under the washer
and under the laterally displaced head member, such that
35 any tilting of the staple under load will serve to press

- 15 -

the head member more firmly onto the tendon thereby ameliorating loosening of the tendon and staple from the bone.

26. The method of claim 25 wherein the staple is inserted
5 into the bone at the required site using an appropriate hammer like tool.

1/3

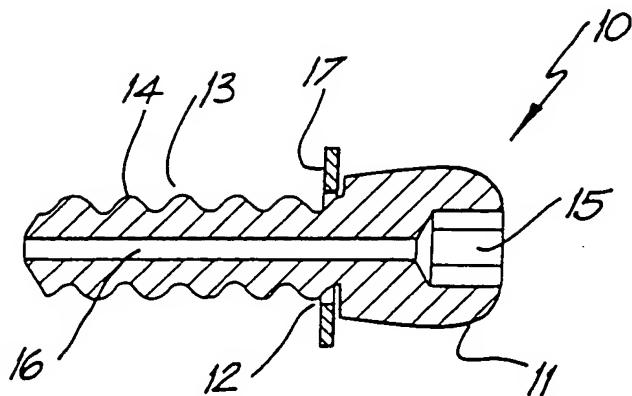


FIG. 1

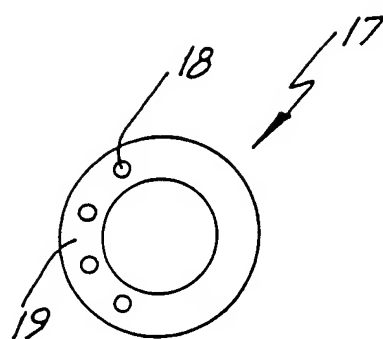


FIG. 2

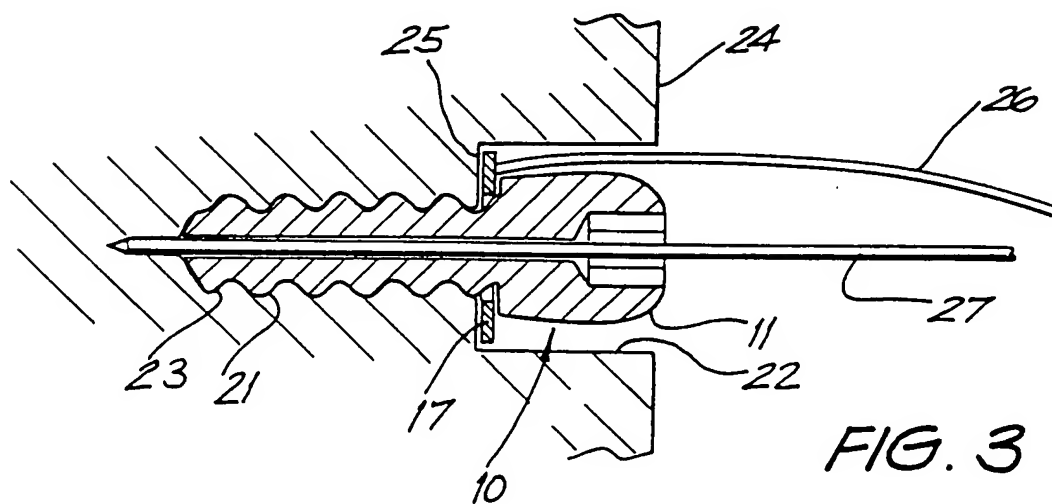


FIG. 3

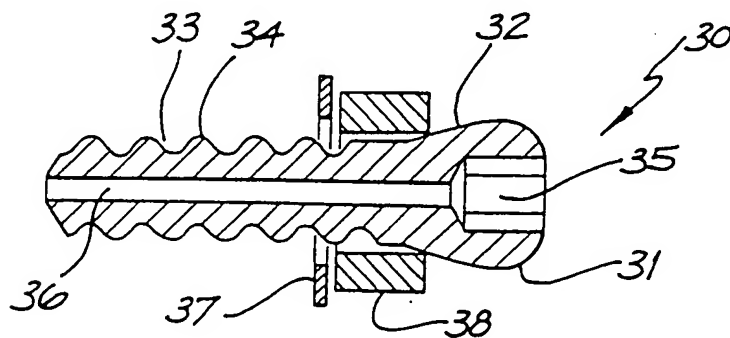


FIG. 4

2/3

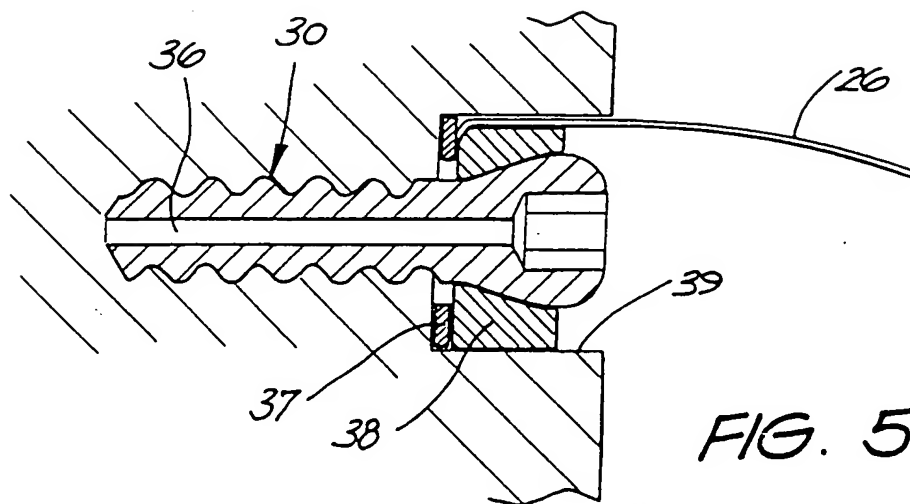


FIG. 5

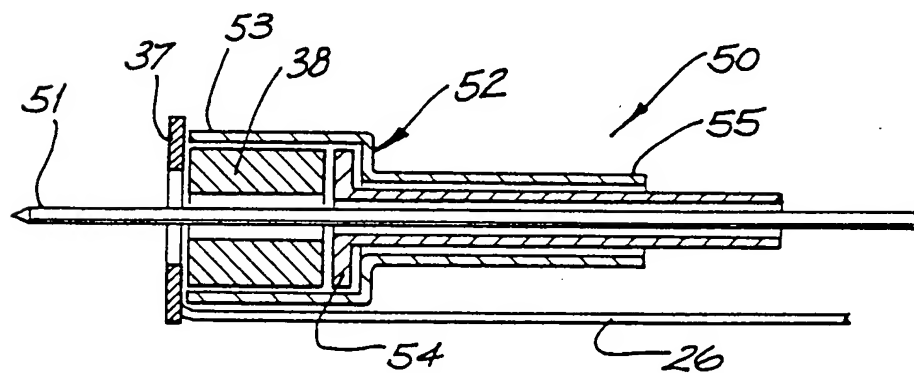


FIG. 6

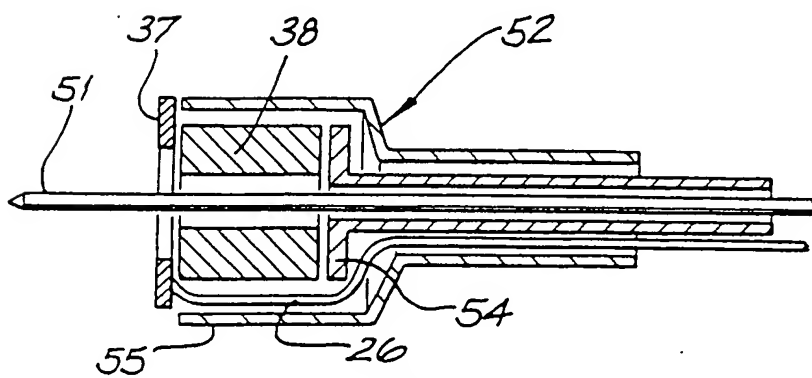


FIG. 7

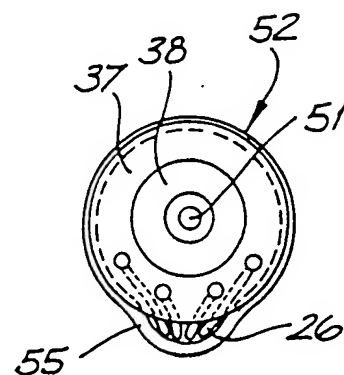


FIG. 8

3/3

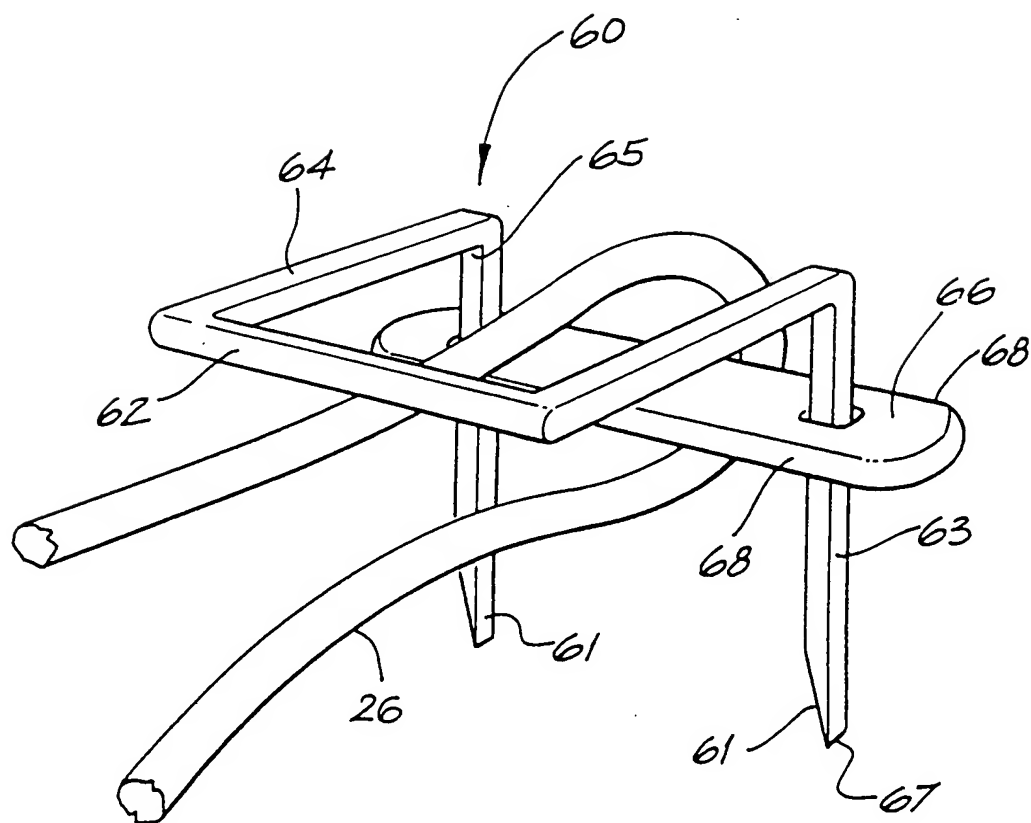


FIG. 9